

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
17 February 2005 (17.02.2005)

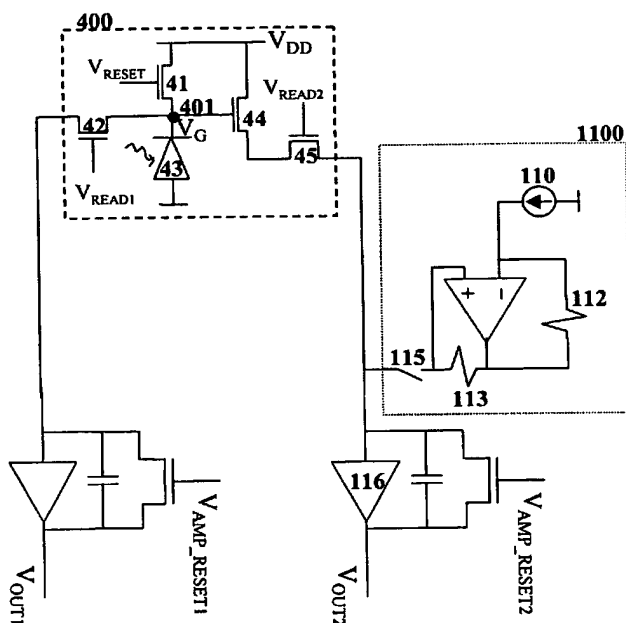
PCT

(10) International Publication Number
WO 2005/015639 A1

- (51) International Patent Classification⁷: **H01L 27/146**, 31/08
- (74) Agent: MBM & CO.; 2200-200 Granville Street, Vancouver, British Columbia V6C 1S4 (CA).
- (21) International Application Number: PCT/CA2004/001457
- (22) International Filing Date: 12 August 2004 (12.08.2004)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
2,437,047 12 August 2003 (12.08.2003) CA
2,450,425 2 December 2003 (02.12.2003) CA
- (71) Applicant (for all designated States except US): **SIMON FRASER UNIVERSITY** [CA/CA]; 8888 University Drive, Burnaby, British Columbia V5A 1S6 (CA).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): **KARIM, Karim, S.** [CA/CA]; 307-2960 Princess Crescent, Coquitlam, British Columbia V3B 7P2 (CA).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: MULTI-MODE DIGITAL IMAGING APPARATUS AND SYSTEM



(57) Abstract: The present invention provides digital imaging architectures comprising detectors coupled to readout circuitry, wherein the readout circuitry functions in particular modes, the use of which can depend on characteristics of the input signals transferred to the readout circuitry from the detectors, or can depend on the characteristics of the output signal required from the readout circuitry. For example, when the input signal has a particular magnitude the readout circuitry can function in a first mode in which the input signal can be amplified to a measurable level, and when the input signal has another magnitude, the readout circuitry can function in an alternate mode in which the input signal can be read out with a different or no amplification. Multiple modes can be implemented to provide various levels of amplification to the input signal, for example, three or more modes of operation of the readout circuitry can be implemented. Furthermore, more than one mode can be used to read out the same input signal. Thus the digital imaging apparatus and system of the present invention can provide a large dynamic range of detection that can be capable of amplifying sensitive input signals from a detector to improve the noise immunity of the input signals to external noise sources as well as capable of reading larger signals with little or no amplification, both

with a fast pixel readout time. The present invention also provides a means of further increasing the dynamic range of detection by implementing a current subtraction circuit in the readout circuitry. This current subtraction circuit can be used to reduce the total amount of current flowing through parts of the readout circuitry which can saturate, for example, when a large charge gain is used. Reducing the total output current can result in an increase in the dynamic range of the apparatus by allowing smaller input signals to be detected due to greater amplification of the input signals, while reducing the likelihood of saturation within the readout circuitry.



Declaration under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.